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[54] **ACTIVE MATRIX DISPLAY DEVICE AND METHOD OF DRIVING SUCH**

[75] Inventors: **Alan G. Knapp**, Crawley; **John M. Shannon**, Whyteleafe; **Alexander D. Annis**, Haywards Heath; **Jeremy N. Sandoe**, Horsham, all of England

[73] Assignee: **U.S. Philips Corporation**, New York, N.Y.

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[58] **Field of Search** 359/55, 56, 61, 359/63, 93, 98, 100, 104, 900; 345/94, 97, 208; 348/792, 793

[56] **References Cited**

U.S. PATENT DOCUMENTS

4,710,768	12/1987	Takeda et al.	340/805
4,728,947	3/1988	Ayliffe et al.	340/805
4,870,398	9/1989	Bos	340/784
5,032,830	7/1991	Koijk	340/784
5,159,325	10/1992	Knijk et al.	340/783

FOREIGN PATENT DOCUMENTS

0523797	1/1993	European Pat. Off.	G09G 3/36
0616311	9/1994	European Pat. Off.	G09G 3/36
2129182	5/1984	United Kingdom	G09G 3/34

Primary Examiner—Glenton B. Burgess
Attorney, Agent, or Firm—Robert J. Kraus

[57] **ABSTRACT**

In an active matrix display device having an army of electro-optic, e.g. liquid crystal, display elements (**12**) which are each connected in series with a two-terminal non-linear device (**15**), such as a MIM type thin film diode, between associated row and column address conductors (**16,17**), and are driven by a circuit, (**20,22**) to produce a display effect by applying a selection signal to each row address conductor in turn and data signals to the column address conductors, a selection signal comprising a voltage pulse signal whose magnitude is increased gradually and in a controlled fashion to a maximum selection voltage amplitude is used so as to reduce the extent of ageing in the non-linear devices and differential ageing effects on display elements driven to different levels over a period of use by reducing peak currents flowing through the non-linear devices. The rising edge of the selection pulse signal is suitably shaped, for example by ramping or stepping, for this purpose. When using a five level row drive waveform comprising positive and negative selection signals and a reset signal, the reset selection signal can be shaped in this way, preferably together with the selection signal of opposite polarity.

21 Claims, 7 Drawing Sheets